supplied to plasma during etching of a workpiece to form a desired shape, wherein a gradual transition in the shape of material that has the desired shape in the workpiece being processed occurs in response to the gradual power change that occurs during the gradual transition in the shape of the material that has the desired shape. The new ground of rejection does not specifically address the limitations of independent claim 59 which requires a stored signal to control the amount of AC power applied to an AC etchant plasma while a workpiece is being etched to form a desired shape of a workpiece, wherein the controlled amount of applied AC power causes gradual pre-programmed changes in the amount of AC power supplied to the etchant plasma during etching of the workpiece, and the stored signal causes the gradual power change to be such as to cause a gradual transition in the shape of material in the workpiece being etched in response to the gradual power change to cause the gradual power change to occur during the gradual transition in the shape of the material.

The allegations in the new rejection are erroneous because Chao et al. has no disclosure of the foregoing limitations. In addition, consideration of the overall operation described in Chao et al. reveals that the foregoing limitations were not contemplated by Chao et al., which employs several steps that would be avoided if Chao et al. had employed the limitations of claims 47 and/or 59. The fact that Chao et al. performed these several steps indicates that Chao et al. did not perform the foregoing operations set forth in claims 47 and/or 59.

The overall objective of Chao et al. was to form a trench having rounded corners, as illustrated by corners 64 and 66 in Figure 1 thereof. As indicated in paragraphs 0044 and 0045, initially trench 212 with sharp top corners 214 and sharp bottom corners 216 is formed using well-known anisotropic etch techniques which cause the top and bottom corners to be sharp. Thereafter the corners are rounded by subjecting the trench to independent remedial etching steps.

Top corner rounding (TCR) of sharp top corner 214 is achieved primarily by a

physical process, that is, ion bombardment, and includes exposing substrate 211 to a plasma formed from a sputtering agent. The plasma is biased toward the substrate to increase the amount of sputtering at top corners 214. The plasma is biased by bias power source 106 (figure 2A) applying at least 50 watts (W), and more preferably between about 100 W and 500 W to pedestal 107; paragraph 0046. Paragraph 0047 indicates that in one implementation the top corner rounding etch process is performed for 40 seconds while the chamber pressure and the process gas flow are maintained constant, as are the powers that (1) supply 105 applies to antenna 106 and (2) supply 106 applies to pedestal 107.

Bottom corner rounding (BCR) of sharp bottom corner 216 is achieved primarily by a chemical process and includes exposing substrate 211 to a plasma formed from a process gas having one or more halogen sources, and preferably including a source such as oxygen for enhancing dissociation of halogen sources or a dilutant, or both; paragraph 0048. The BCR is considered by the examiner to meet the requirement of claim 47 to form a desired shape.

The BCR etch process uses high ion flux and low ion energy. The low ion energy is achieved by turning off source 106 that applies power to pedestal 107 or by adjusting source 106 so it applies a minimal amount of power, no more than 50 W, to pedestal 107 to eliminate or at least minimize physical etching; paragraph 0049. The last sentence of paragraph 0048 states: "Generally, increasing the source power, increasing the chamber pressure, increasing the flow rate of SF_6 or CF_4, all increase the amount of rounding occurring at the bottom corners." The term "source power" in this sentence refers to the power that source 105 applies to antenna 102. This sentence merely means that higher values of any of these parameters during a first etching process compared to a second etching process result in an increase in the amount of rounding. It does not mean there is an increase in these parameters during the etching process of sharp bottom corner 216, and does not mean there is a gradual increase in the power that source 105 applies to antenna 102 during the etching process.

Paragraph 0050 describes one specific implementation of the rounding process of sharp bottom corner 216. During this implementation, chamber pressure and process gas flow rate are maintained at constant values, as is the power that source 105 supplies to antenna 102. During the bottom corner rounding process bias power supply 106 applies no more than 50 W to pedestal 107, or applies no power to the pedestal to minimize high-speed ion bombardment against the substrate 211. Paragraph 0050 includes the following sentence: "Lowering source power increases the etch uniformity but decreases the etch rate." The words "source power" in this sentence refer to the power that source 105 supplies to antenna 102. This sentence merely means that if the power that source 105 supplies to antenna 102 during the bottom etching process is lower during a first operation than during a second operation there is a lower etch rate during the first operation than during the second operation. It does not mean there is a decrease in the power that source 105 supplies to antenna 102 during the etching process of sharp bottom corner 216, and does not mean there is a gradual decrease in the power that source 105 applies to antenna 102 during the etching process.

As indicated by paragraphs 0051 and 0052, after the top and bottom of rounding corner processes have been completed, the damaged outer surfaces 218 of the trench are removed in soft etch process step 210 that is primarily a chemical process, similar to the bottom corner rounding process. Paragraph 0052 describes the soft etch process for one particular implementation in terminology very similar to that employed in paragraph 0050 for the bottom corner rounding process. In particular, paragraph 0052 includes the sentence: "Lowering source power increases the etch uniformity but decreases the etch rate." This sentence, which is identical to the previously quoted corresponding sentence in paragraph 0050, merely indicates that if the source power is lower during a first operation than it is during a second operation, the etch rate of damaged outer surfaces 218 during the first operation is less than the etch rate during the second operation.

Tables 1 and 2 in paragraphs 0054 and 0055 specify ranges for various parameters for a pair of process recipes. In both of these recipes, the bias power (Wb) and the source power (Ws) for top corner rounding, bottom corner rounding and soft etch are in the same ranges, as is the duration of the processes. There is no indication that the bias power or the source power varies during the processes.

Claim 1 of the Chao et al. application as filed (which closely corresponds to claim 1 of the issued patent 6,599,842), in combination with claim 2 of the application as filed indicates the top corner rounding process step is exposing a substrate to a plasma formed from a first process gas consisting essentially of a sputtering agent by applying RF energy from a power source system to a coil and the biasing the plasma toward a substrate by applying bias power to the substrate processing chamber. Claims 1 and 2 of the Chao et al. application as filed also indicate the bottom corner rounding process step is exposing the substrate to a plasma formed from a second process gas without applying bias power or applying minimal bias power to the substrate process chamber. None of the claims of either the Chao et al. application or the patent which matured from this application mention anything about gradually changing power. Hence, neither the specification nor the claims of the Chao et al. application and the patent which matured from it have any disclosure of gradually changing power applied to the plasma during the corner rounding processes. Corner rounding is achieved either by exposing a substrate to a plasma formed (1) by a first process gas consisting essentially of a sputtering agent while RF energy is applied to a coil and plasma is biased toward a substrate by applying bias power to a substrate pedestal or (2) from a second process gas without applying bias power or applying minimal bias power to a substrate pedestal, while RF energy is applied to the coil.

Based on the foregoing, Chao et al. has no disclosure of the requirement of claim 47 for gradually changing, on a pre-programmed basis, the amount of AC power supplied to plasma during etching of a workpiece to form a desired shape, wherein a

gradual transition in the shape of material that has the desired shape in the workpiece being processed occurs in response to the gradual power change that occurs during the gradual transition in the shape of the material that has the desired shape. Similarly, there is no disclosure in Chao et al. of the requirement of claim 59 for a stored signal to control the amount of AC power applied to an AC etchant plasma while a workpiece is being etched to form a desired shape of a workpiece, wherein the controlled amount of applied AC power causes gradual pre-programmed changes in the amount of AC power supplied to the etchant plasma during etching of the workpiece, and the stored signal causes the gradual power change to be such as to cause a gradual transition in the shape of material in the workpiece being etched in response to the gradual power change to cause the gradual power change to occur during the gradual transition in the shape of the material.

There is no basis for the statement in the sentences in the paragraph at the top of page 9 of the Examiner's Answer that Chao et al. has a disclosure of gradually changing the power supplied to the plasma during etching of the workpiece to form the desired shape, wherein a gradual transition in the shape of material in the workpiece being processed occurs in response to the gradual power change that occurs during the gradual transition in the shape of the material. Appellants have demonstrated that paragraphs 0048 and 0049 of Chao et al. do not disclose such gradual power changes.

Consideration of the overall operation of Chao et al. indicates that Chao et al. did not have possession of the foregoing gradual power change requirements of claims 47 and/or 59. If Chao et al. had possession of the gradual power change requirements of claims 47 and/or 59, the anisotropic etch process used to etch the trench and which produced the sharp corners at the top and bottom of the trench would not have been employed. Instead, rounded corners would have been initially formed by using the gradual power change concept. The use of appellants' gradual power change concept would have avoided the need to perform the top and bottom rounding corner processes after the formation of a trench having sharp corners. In addition, the use of appellants'

gradual power changing concept probably would have avoided the soft etch process needed to repair the damaged outer surfaces 218 that are made rough by the anisotropic etch process, as described in paragraph 0045 of Chao et al.. Further, the use of appellants' gradual power changing concept probably would have avoided the need to remove substrate 211 from process chamber 101, as described in paragraph 0045 of Chao et al..

B. Many of the dependent claims distinguish over Chao et al.

Claims 50, 51, 56-58 and 61-63 all mention the gradual power change. As discussed supra, in connection with claims 47 and 59, Chao et al. does not disclose a gradual power change.

Claims 54 and 58 indicate the gradual change includes steps having power changes no greater than about several watts, and that the power remains at a constant wattage for no more than about one second. Claims 55 and 57 indicate the power steps are a few milliwatts and that the steps remain constant for about 1 millisecond. Claim 56 indicates the steps have a maximum change of less than 5% of an electric source maximum output power. Claims 65 and 66 indicate the gradual changes are steps having power changes in the range of a few milliwatts to several watts and having durations in the range of about 1 millisecond to no more than one second.

Chao et al. has no disclosure of step changes in power applied to either antenna 102 or pedestal 107 during processing of substrate 211 during the BCR operation. Consequently, Chao et al. has no disclosure of the foregoing limitations of claims 54 and 65, nor does it include any disclosure that would cause one of ordinary skill in the art to provide step changes as set forth in claims 54-58 or 65 and 66. The examiner has ignored the fact that appellants discovered that the power should remain at a constant value for no more than about one second because steps longer than this time do not have adequate temporal resolution to achieve the desired workpiece shapes and